

## 1. Minimum Mean Square Error (MMSE) Linear Filters

1. The four original images *img14g.tif*, *img14bl.tif*, *img14gn.tif*, and *img14sp.tif*



*Figure 1: img14g.tif*



*Figure 2: img14bl.tif*

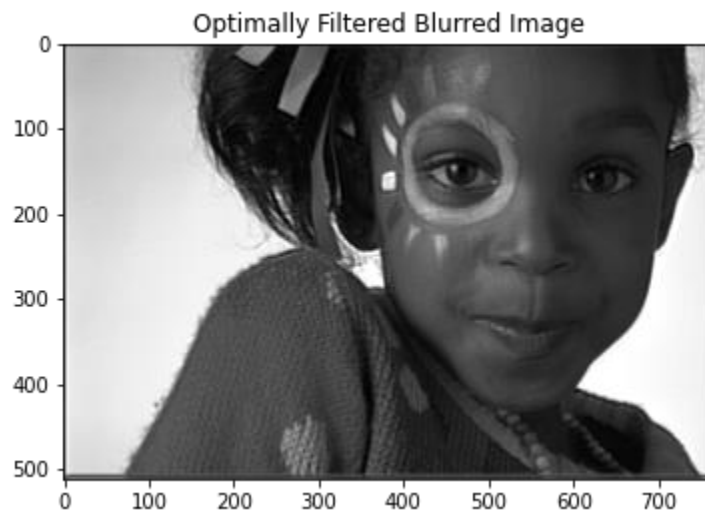


*Figure 3: img14gn.tif*

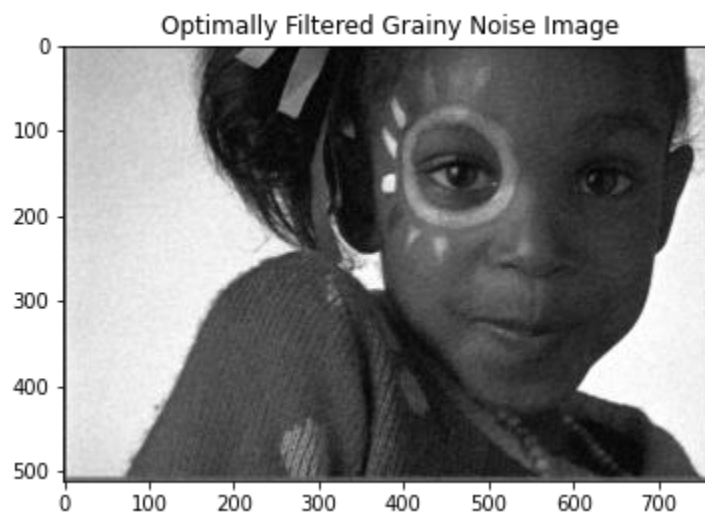


*Figure 4: img14sp.tif*

2. The output of the optimal filtering for the blurred image and the two noisy images



*Figure 5: Blurred restoration*



*Figure 6: Grainy Restoration*

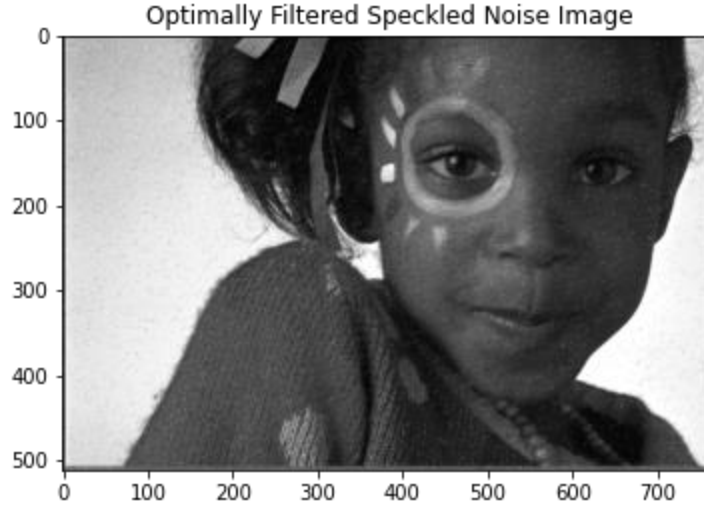


Figure 7: Speckled Restoration

3. The MMSE filters that were computed for the blurred image and the two noisy images

Blurred Image (*img14bl.tif*) Filter (Sum of  $\theta^* = 1.0045$ ):

$$\theta^* = \begin{bmatrix} [-0.15004272 & -2.20316248 & -1.53751595 & 0.132943 & 0.55777773 & 1.17828702 & -0.39453129] \\ [2.13349788 & 2.79318104 & 0.92583732 & -0.32647502 & 1.57534302 & 0.06452982 & 0.01833554] \\ [-0.37621506 & -1.7785595 & -0.50835566 & 1.74945865 & -1.47907556 & -1.04886715 & 0.05890131] \\ [-0.2209119 & 0.65281846 & -0.01923163 & 0.04764148 & -1.50344027 & -0.93024642 & -2.39822353] \\ [-2.51493618 & -0.78082127 & 0.83805166 & -2.40253735 & 0.08848512 & 2.54612612 & -0.61383685] \\ [-0.5024801 & 4.65451482 & 0.35021105 & -2.45114035 & 1.78221221 & 5.45638826 & 1.11487593] \\ [0.21506558 & 0.63355317 & -0.43247633 & -3.73569145 & -1.21106988 & 4.53496933 & -3.57861374] \end{bmatrix}$$

Grainy Noisy Image (*img14gn.tif*) Filter (Sum of  $\theta^* = 1.0082$ ):

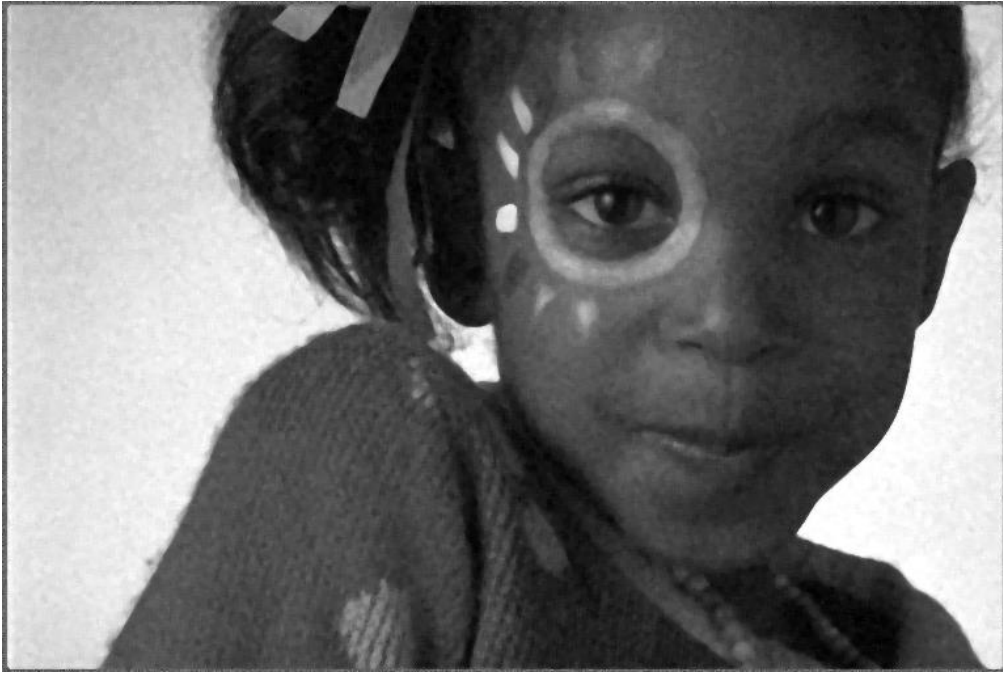
$$\theta^* = \begin{bmatrix} [-0.02985835 & -0.00114814 & 0.01621721 & -0.01882117 & 0.00834596 & 0.01681519 & -0.02012423] \\ [-0.02547792 & 0.01879946 & 0.00257666 & -0.0467791 & -0.0076382 & -0.02682051 & 0.0079573] \\ [0.0175498 & 0.01970885 & 0.00225612 & 0.04266198 & 0.03079341 & -0.00767855 & 0.01380388] \\ [-0.01904948 & 0.00742443 & 0.0063532 & -0.00808864 & -0.02631122 & 0.01837885 & 0.04115626] \\ [-0.01327874 & 0.01474441 & 0.01374941 & -0.01074971 & -0.0100289 & -0.00147149 & 0.0588481] \\ [-0.03977672 & -0.02348193 & -0.04029758 & -0.03639427 & -0.03256087 & 0.03986435 & 0.17840736] \\ [0.03629389 & 0.03850956 & 0.05919588 & 0.05903991 & 0.08974773 & 0.18335814 & 0.41151886] \end{bmatrix}$$

Speckled Noisy Image (*img14sp.tif*) Filter (Sum of  $\theta^* = 1.0054$ ):

$$\theta^* = \begin{bmatrix} [-0.03008728 & -0.0322477 & 0.0213336 & -0.04465128 & -0.01242194 & 0.01097982 & 0.00387093] \\ [-0.01064806 & 0.00622445 & 0.02520621 & 0.0096052 & -0.02261044 & -0.04280791 & -0.00317061] \\ [-0.00438541 & 0.0190518 & 0.0090709 & 0.03551449 & 0.01880543 & 0.03731365 & 0.03801995] \\ [0.00232254 & -0.03511802 & 0.00973322 & -0.00241192 & -0.00890723 & -0.04438832 & -0.00998791] \\ [-0.00913994 & 0.00173587 & 0.00046863 & -0.01861896 & -0.01917184 & 0.05496598 & 0.08864654] \\ [-0.02939398 & -0.03493552 & -0.02008879 & -0.03894411 & -0.00201718 & 0.04792006 & 0.17068996] \\ [0.0559715 & 0.04983432 & 0.07536619 & 0.01987913 & 0.08651964 & 0.13957389 & 0.44292771] \end{bmatrix}$$

## 2. Weighted Median Filtering

### 1. Results of median filtering



*Figure 8: Weighted Median Filtered Result for img14gn.tif*



*Figure 9: Weighted Median Filtered Result for img14sp.tif*

### 2. Attached C Code → \*See Next Page\*